Intestinal Parasites of the Lizard *Lygosoma laterale*

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The intestinal parasites of *Lygosoma laterale,* the ground skink, have been described by Harwood (1932) and by Byrd (1937). In a later paper, Harwood (1936) correlated the incidence of several parasite species with the type of soil habitat associated with *Lygosoma* near Houston, Texas.

As part of a study on the biology of *Lygosoma* in Florida, data were obtained which relate degree of parasitism with host age, sex, and locality. These data also afford a comparison between two widely separated populations of a single species. Information concerning the food habits and population ecology of *Lygosoma* can be found in Brooks (1963, 1967).

Methods and Materials

Between August, 1960, and April, 1962, 381 skinks, of which 269 were adults, were collected near Gainesville, Florida. Adults are defined as those with a snout-vent length (SVL) of 35 mm or longer; juveniles, as those with a SVL of 34 mm or less. In each individual, the entire digestive tract and the body cavity were examined under a dissecting scope. Parasites were prepared for study following standard procedures. Dr. M. A. Byrd, College of William and Mary, aided me with species identification. Soil descriptions were taken from "Soil Survey: Alachua County, Florida", Series 1940, No. 10, produced by the U.S. Department of Agriculture.

Description of Localities

Five populations of *Lygosoma* were restricted to very localized areas, each of which afforded a sufficiently large sample size to allow a comparison of parasite incidency between sites. None of the localities, however, was uniformly sampled over a year's period. The five localities, their soil types, and their dominant vegetation are described below. At all sites, *Pinus taeda* was the most frequent species of pine and *Quercus laurifolia* and *Q. nigra* the most abundant species of oaks.

Site A. This locality was in the Medicinal Plant Gardens on the

University of Florida campus and contained soil described as Fellowship loamy fine sand. Dominant vegetation consisted of pines and oaks; the herb layer, mainly grasses and sedges, was periodically mowed. A small stream flowed through the center of this site.

Site B. This locality was a cleared, well-drained, park-like area bordered by pine woods. The soil is a complex of Arredondo-Fellowship loamy fine sands. Dominant vegetation consisted of scattered pines and oaks with a herb layer of grasses, sedges, and weeds.

Site C. This site, located in a park-like pasture on a gentle slope, has soil described as Fellowship loamy fine sand which retains moisture and is well suited for pasture grasses. Dominant vegetation consisted of scattered pines, oaks, and hickories, with no understory; pasture grass and weeds comprised the herb layer. A small herd of beef cattle roamed freely through this site.

Side D. This locality consisted of overgrown lawns near two abandoned dwellings, and the adjacent wooded areas. The soil, Kanapaha fine sand which typically has good surface and internal drainage, contained a variable amount of organic material. Scattered pines and oaks, and a mixture of weeds, lawn grass, and sedges at the herb layer constituted the dominant vegetation.

Site E. This site consisted of a small woods and adjacent cleared areas, and contained soil classified as Arredondo loamy fine sand-fine sand complex. The wooded area was a mixed deciduous forest but some clearing of the understory had occurred prior to this study. A small stream flowed through a portion of this site.

Results

Five species of worms were recovered, four of which had been described previously by Harwood (1932). Four of the worms could definitely be identified, a tapeworm, *Cylindrotaenia americana;* a fluke, *Mesocoelium americanum;* and two nematodes, *Physaloptera squamatae* and *Thubunaea leiolopismae.* The fifth worm was an unidentified larval acanthocephalan.

Yamaguti (1959) lists the nematotaeniid tapeworm, *C. americana,* as being found in various anurans (*Bufo, Hyla, Acris, Rana, Pseudacris, Leptodactylus, Scaphiopus,* and *Arthroleptis*), in one genus of salamander (*Desmognathus*), and in *Lygosoma.* Har-

TABLE 1

Percentage of parasitism and mean number of parasites per skink in adult males and females and juvenile *Lygosoma laterale*

	Adults						
	Males		Females		Sub-Total	Juveniles	Total
Parasite	%	Mean	%	Mean	%	%	%
C. americana (CA)	50	—	55	—	53	40	49
M. americanum (MA)	22	6.0	30	5.3	28	25	27
T. leiolopismae (TL)	36	4.2	28	5.2	32	14	27
P. squamatae (PS)	32	2.1	24	2.3	28	6	22
(PS) + (TL)	57	4.0	44	4.7	51	19	42
(CA) + (MA)	10	—	15	—	12	9	11
(MA), (TL) + (PS)	12	—	9	—	10	2	8
(CA), (MA), (TL) + (PS)	4	—	6	—	5	0	3
No Parasite	13	—	11	—	12	33	18
Host sample size	144		125		269	112	381

wood (1932), however, seriously questioned Joyeux's (1924) identification of *C. americana* in the South African frog genus *Arthroleptis*. The number of tapeworms per skink was not determined since they broke into numerous fragments when removed and were unfortunately discarded. All were located in the intestine immediately posterior to the pyloric sphincter.

All of the flukes found could be assigned to *Mesocoelium americanum*. This species was found in two genera of lizards (*Eumeces* and *Lygosoma*) and in a snake (*Storeria*) by Harwood (1932). In adult skinks, the number of flukes ranged from 1-33 (mean = 5.6) and in juveniles from 1-27 (mean = 4.8). In both groups all were found in the intestine immediately posterior to the pyloric sphincter.

The two species of nematodes were both spiruroids. Harwood (1932) lists *Physaloptera squamatae* as being found in *Lygosoma* and in a snake, *Agkistrodon*; *Thubunaea leiolopismae*, in *Lygosoma* and in a frog, *Acris*. Individuals were found mainly within the stomach, esophagus, or encysted on the stomach wall. In a few cases several were found in the intestine or free in the body cavity. In adult skinks, the number of *P. squamatae* ranged from 1-15 (mean = 2.2), that of *T. leiolopismae* from 1-33 (mean = 4.6).

Three larval acanthocephalans were found encysted in the posterior intestine; one in one lizard, two in another.

Table 1 shows the percentage of male and female adult and

TABLE 2

Percentage of parasitism and mean number of parasites per skink in *L. laterale* listed by size group

	Snout-vent length in mm									
	18–25		26–30		31–35		36–40		41–50	
Parasite	%	Mean	%	Mean	%	Mean	%	Mean	%	Mean
C. americana	40	—	43	—	51	—	56	—	49	—
M. americanum	17	1.4	23	5.5	33	5.8	32	5.7	23	5.7
P. squamatae	7	1.0	6	1.7	8	2.5	28	2.2	34	2.4
T. leiolopismae	0	—	9	1.0	20	1.6	22	3.4	47	5.1
P. squamatae + *T. leiolopismae*	7	1.0	15	1.3	29	1.9	42	3.3	65	5.0
No Parasites	47	—	34	—	18	—	15	—	9	—
Age in Months*	0–3		3–6		6–10		9–18		14–42	
Sample size	30		47		49		132		123	

*From Brooks (1967).

juvenile skinks parasitized. Adults have a higher percentage of parasitism in all categories. Although seemingly striking, the percentage differences of parasitism between adult males and females, even in the case of nematodes, are not significant (tapeworms: $\chi^2=0.38$, $P>0.05$; flukes: $\chi^2=1.86$, $P>0.05$; nematodes: $\chi^2=2.38$, $P>0.05$). The probability of an adult skink harboring all three types of worms could be expressed as $0.53\times0.28\times0.51$ or 7.6 per cent (see Table 1), whereas the observed frequency is only 4.5 per cent. Likewise, the expected frequencies of adults harboring tapeworms and flukes, tapeworms and nematodes, and flukes and nematodes could be estimated as 14.8 per cent, 27.0 per cent, and 14.3 per cent respectively. There is no significant difference between the expected and observed values ($\chi^2=2.86$, $P>0.05$).

Table 2 lists the percentage of parasitism for five age groups of *Lygosoma* (age can be estimated by snout-vent length, see Fig. 6 in Brooks, 1967). The incidence of both species of nematodes and the mean number per skink are directly correlated with age; that of tapeworms and flukes are not. Both tapeworm and fluke parasitism decrease slightly in the oldest age group. The number of nonparasitized skinks decreases with increasing age.

The percentages of parasitism for adult skinks from five different localities are given in Table 3. Each locality has a unique distribution of parasite occurrence. The greatest difference appears between Sites C and E, where the difference in fluke incidence is 10× and in nematode incidence, 6×.

TABLE 3

Percentage of parasitism and mean number of parasites per skink in five populations of *L. laterale adults*

	Locality									
	A		B		C		D		E	
Parasite	%	Mean	%	Mean	%	Mean	%	Mean	%	Mean
C. americana	43	—	68	—	76	—	42	—	65	—
M. americanum	41	6.5	18	1.3	66	9.8	16	3.0	6	3.3
T. leiolopismae	39	3.9	18	2.8	0	—	23	2.1	56	5.3
P. squamatae	33	1.4	32	1.4	10	1.7	54	2.3	13	1.3
T. leiolopismae + *P. squamatae*	51	3.9	50	1.9	10	1.7	63	2.7	58	5.5
No parasites	12	—	11	—	3	—	26	—	10	—
Sample size	49		28		29		43		48	

Discussion

Harwood (1932) found several worms, a fluke, *Brachycoelium daviesi,* in 23 per cent, and two nematodes, *Oswaldocruzia pipiens* and *Cosmocercoides dukae,* both in less than 5 per cent of his specimens, that were not identified in Floridian skinks. My results also differ from his in a quantitative manner. For all species in common the incidence of parasitism in Floridian skinks was appreciably higher than in the Texan population.

C. americana was present in 37 per cent of the Texas skinks (Harwood, 1932) and were abundant in skinks living on clay soils but absent from those living on sandy soils (Harwood, 1936). The high incidence of infection (53 per cent) by this worm in Floridian skinks might be explained by habitat differences. All of the Floridian skinks were collected on a substrate of loamy fine sand or fine sand. Harwood (1936) offered no explanation for the correlation between clay soils and incidence of *C. americana,* and since my results are in direct opposition, any explanation must await an understanding of the life history of *C. americana.* If *C. americana* has a direct life cycle as suggested by Joyeux (1924), the major limiting environmental factor night well be moisture content (see below) rather than soil type per se.

Less than 5 per cent of the Texan skinks were parasitized by *M. americanum* (Harwood, 1932) compared to 28 per cent for Floridian skinks. Since the life history of this fluke is unknown, it is not possible to compare intermediate host prevalence and ecology between the two sites. Approximately 10 per cent of 381 skinks from Florida contained pulmonate snails as food items (Brooks, 1963). There are no comparable data for the Texan skinks.

Thubuneae leiolopismae and *Physaloptera squamatae* were found in less than 20 per cent and 4 per cent respectively of Texan skinks (Harwood, 1932). Comparable figures for adult, Floridian skinks were 32 per cent and 28 per cent respectively. Again, it is not feasible to attempt an explanation of these differences since the life histories of these nematodes are not known.

Locality site has a profound effect on the incidence of parasitism (Table 3). The level of parasitism by *C. americana* is the least variable, but a range from 42-76 per cent is significant. These extreme differences between localities, especially in the case of the

fluke and nematodes, emphasizes the importance of local habitat conditions on parasite species abundance.

Since even the smallest skinks have a high level of tapeworm parasitism (Tables 1 and 2), *C. americana* might either have a direct life cycle (see Joyeux, 1924) or a small and relatively common intermediate host(s). *Cylindrotaenia americana* produces proglottids, each containing eight embryos, which exit within fecal pellets. The fecal mass of *Lygosoma* is relatively moist compared with that of other lizards, and mature proglottids can be seen moving on the deposited mass. An interesting question is whether another, or the same skink, would eat these proglottids. Small skinks feed on very small food items and motion is the stimulus which initiates feeding behavior.

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